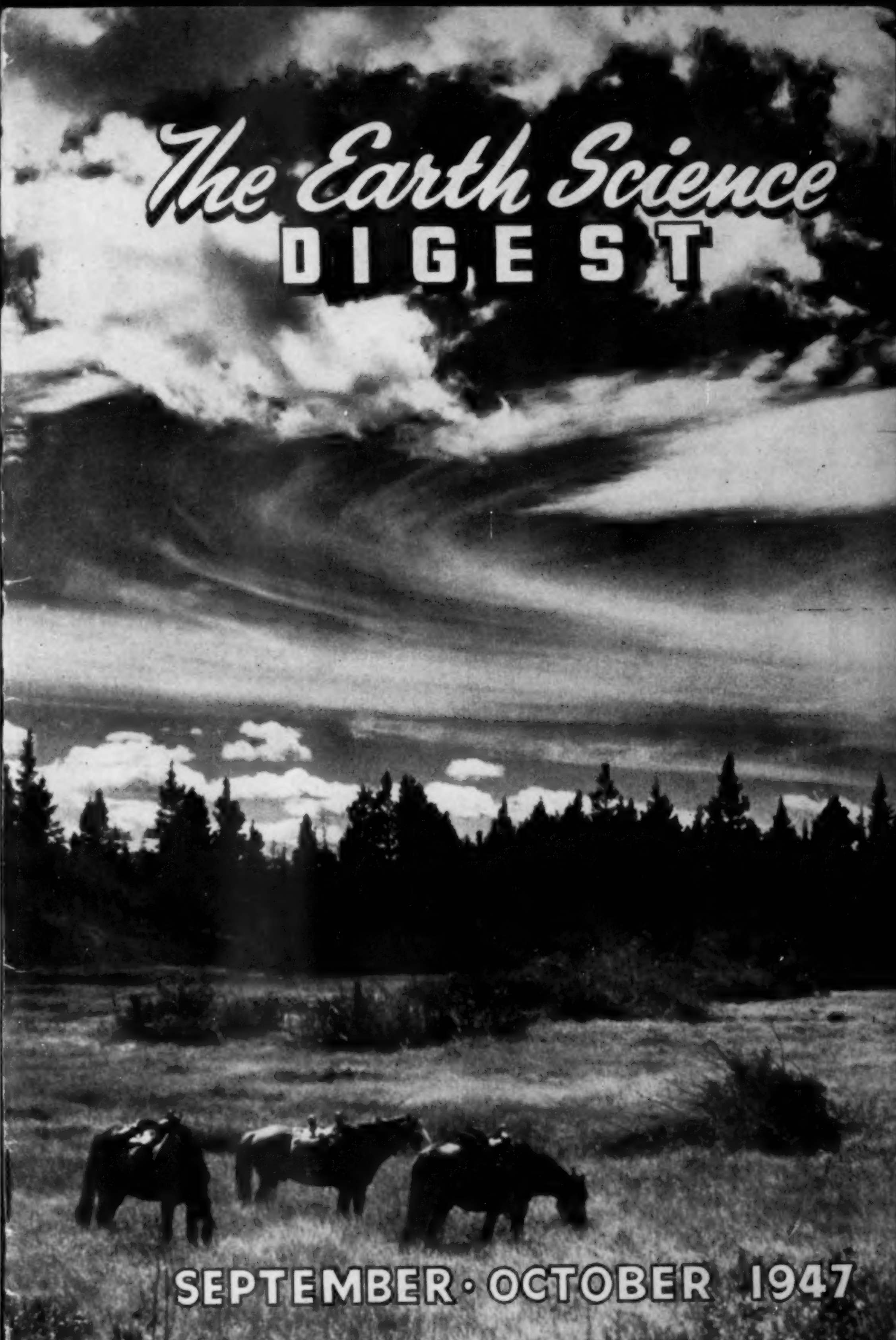
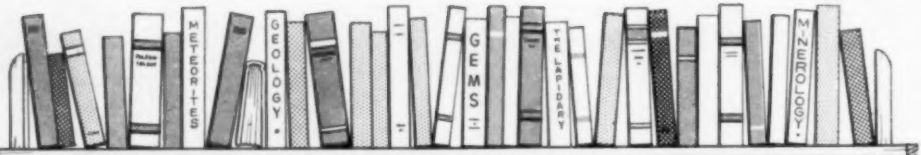

The Earth Science
DIGEST
SEPTEMBER · OCTOBER 1947



The BOOK SHELF

Handbook of Uranium Minerals by DeMent and Dake. An exposition and catalog of the Uranium and Thorium minerals, including methods for their detection, location and exporation. An invaluable aid to all prospectors and miners on the lookout for these important minerals.
Price: $1.50.

Revised Lapidary Handbook by Howard. This book is the successor to the author's Handbook for the Amateur Lapidary. A must for all gem cutters and potential gem cutters. **Price: $3.00.**

The Gem Hunter's Guide by Russell P. Macfall. A list of all important gem locales in the United States with information on not only where to find gems, but how to find them. Well illustrated. **Price: $1.00.**

Jewelry, Gem Cutting and Metalcraft by W. T. Baxter. Detailed methods of jewelry making, metalcraft, and gem stone cutting. Gives practical hints as to the best tools and materials, and such incidental information as how to cast rings, etc. **Price: $2.75.**

BENJAMIN SILLIMAN: Pathfinder in American Science. Just off the press. Recommended by the Book-of-the-Month Club. The life of "the father of American scientific education," interestingly told by John F. Fulton, Sterling professor of physiology at Yale, and Elizabeth H. Thomson, research assistant in the historical library of the Yale University School of Medicine. Illustrated. Reviewed in this issue. **Price: $4.00.**

The Art of Gem Cutting by Dake and Pearl. Anyone who contemplates pursuing the hobby of gem cutting should have a copy of this book. Written by H. C. Dake, editor of The Mineralogist Magazine, and Richard M. Pearl of Colorado College, it presents a wide variety of material on the most interesting of all hobbys. **Price: $1.50.**

BACK ISSUES OF **THE EARTH SCIENCE DIGEST.** For a limited time only we can supply a bundle of the following back issues for $1.00. October 1946, November 1946, December 1946, January 1947, February 1947. We have exhausted our supply of March 1947 copies. There will be no more of these available.

The Earth Science **DIGEST**

BOX 581 ANN ARBOR, MICHIGAN

The Earth Science Digest

Box 581

Ann Arbor, Michigan

Published monthly by
THE EARTH SCIENCE PUBLISHING CO.

Hendrik P. Zuidema............Editor and Publisher
Robert B. Berry............Associate Editor
J. Charles Gillette............Advertising Manager
Alice L. Hart............Circulation and Business Manager

A magazine devoted to the advancement of the geological sciences.

SUBSCRIPTIONS

Per copy	$ .25
1 year	2.00
2 years	3.75
3 years	5.00

Contributors are advised to retain copies of their manuscripts to avoid taking unnecessary risk. Every effort will be made to return unused manuscripts, photographs and sketches if accompanied by ample first-class postage and name and address, but we will not be responsible for loss of such material.

Advertising rate card will be sent upon request.

Vol. II Sept.-Oct.-1947 No. 2

Contents

	Page
Cover Photo	3
Our Atmosphere	5
Lake Superior Agate (Pt. II)	9
Famous Lost Mines	15
Lepidodendron	21
Book Review	29
Gems from Geology	30

EDITORIAL

The September and October issues of *The Earth Science Digest* are combined, thereby enabling this magazine to resume its former schedule of going to press early in the month of issue. The November issue will go to press early in November.

The acute shortage of paper of the type we demand to insure proper reproduction of illustrations delayed the issuance of the monthly numbers earlier in the year. We now are assured of a supply of paper adequate for our growing list of readers.

Expiration dates of individual subscriptions, accordingly, are extended one. month.

Our correspondents will note that the *Digest* offices have been moved to Ann Arbor, Michigan.

COVER PHOTO

Autumn skies are bright in the Canadian West but the aspen now are golden flashes against the background of pine and spruce and the wind carries a hint of the freeze-up soon to come. The prospector heeds the warning as he breaks camp at the end of another summer in the field. Photo by the Editor in northern British Columbia.

Sand-blasted spherical outcrops of sandstone in "Rock City" near Minneapolis, Kansas.
—Henry K. Ward Photo.

OUR ATMOSPHERE

The Invisible Wind Is a Powerful Geologic Agent

W. D. Keller

University of Missouri

"As light as the air" is a popular way of expressing the idea of almost no weight at all. But now let us ask ourselves, actually how light is the air? Probably the average sized room occupied by readers of this article measures about 12 feet by 16 feet and has a ceiling 10 feet high—what is the weight of air in a room this size? By weight is not meant the pressure—(pounds per square inch) but the actual w e i g h t in pounds which that air would register if bottled up and weighed on a scale. To make it more concrete is the weight of air in that room at normal conditions closest to 1.5 pounds, 15 pounds, 150 pounds, or 1500 pounds? Check the weight that you think best and then turn to the last of this article and you will find the most nearly correct answer. If you estimated correctly you have done better than the average student of earth science with which the writer has had experience. Under ordinary conditions about 12 cubic feet of air at the earth's surface weighs c l o s e to 1 pound.

The blanket of air which envelops the earth is a very interesting atmosphere. The weather "which everybody talks about and nobody does anything about", in the words of Mark Twain, is generated in the atmosphere. Perhaps in a few years Mark Twain's statement will be scientifically incorrect because at least one slight fall of s n o w has been started by man experimentally, and some of our more liberal optimists have predicted that in the near fu-

ture we may be able to prevent the thunderstorm on the Fourth of July picnic, or to break a prolonged drought which has been starving our food crops for moisture. If it does become possible to control the weather what a change the relatively passive science of meteorology and weather forecasting will undergo to integrate with aggressive "weather engineering" which we suppose would be controlled variously by the Government, Capital, Labor, Agriculture and Visiting Notables who want to see Death Valley desert sand dunes before and after a cloud burst! There seems to be almost no limit to which an imaginative science may be put.

Our atmosphere is composed of about 78 per cent nitrogen, about 21 per cent oxygen, and less than 1 per cent of neon, carbon dioxide, argon and other gases. The air or atmosphere becomes thinner outward from the globe, or up as it is commonly called, and the temperature decreases at a rate of about 1 degree F. with every 300 feet rise until the stratosphere is reached, and there the temperature practically ceases to change with further rise. The temperature of the stratosphere has been reported as varying from -80 degrees C. (20 kilometers high) in the equatorial belt to -42 degrees C. (8½ kilometers high) in the polar region. This distribution of temperature in the stratosphere is not what most of us would expect, but surprises usually enhance our interest in any subject.

The atmosphere in motion is called wind and that physical agent plays quite a significant part in modifying our earth surface and doing geological work. By way of introduction it is the one agent which very commonly transports a significant part of its load to appreciably *higher* levels than those from which they were derived. This differs from water runs down hill whether it is on the surface of the earth or underground, and from ice which although it may temporarily rise as it overrides a local elevation, still must move down hill under the influence of gravity. Strong winds are readily able to pick up sand and dust from the lowest point in our United States (near Bad Water, Death Valley, California) and lift the dust to the highest mountain peak in the United States, Mt. Whitney, only a few miles to the west. The wind when equipped with abrasive quartz sand may scour our inland areas deeper and deeper, even below sea level, limited only in speed by the most enduring of rocks, and stopped only when it reaches the unobtrusive "mild mannered" groundwater table. Here is again one of those interesting natural checks and balances of Mother Nature.

Although the most spectacular work of the atmosphere is its transportation and deposition yet some very interesting and curious erosional features are developed on rocks which have long been exposed to atmospheric effect. A dreikanter is a common form of ventifact in which a boulder has been wind carved and polished so that three edges and three faces have been cut above the base which is buried in the ground. Dreikanters are a popular collectors item. The name is a German word meaning "three edges", originally used to describe them, and which has been so illustrative that it has been adopted in our own language. Wind-carved rocks with a single edge or ridge are correspondingly called einkanters, and others with four, five, or six edges are appropriately given the corresponding German names.

Various mushroom shaped rocks or pedestal rocks are said to have their shapes developed largely by pronounced wind erosion near their bases while their overhanging shelves

Dunes of Gypsum in White Sands National Monument, New Mexico.
—Fritz Henle Photo.

are thought to remain extended because wind erosion rapidly diminishes a few inches above the ground. Not all geologists are in full accord with this explanation and some believe that rain water percolating

A pinnacle of rock protected by a more resistant cap rock. Big Badlands of South Dakota.

through the rocks has weathered and dissolved the lower parts so that they are more readily removed, giving rise to a mushroom shape.

Some notable examples of high polish on rocks by wind action have been found in our Western states in desert regions and in canyons through which the wind blows with high velocity, and on certain sand beaches. Wind and sand often sandblasts telephone and telegraph poles near their bases in arid regions and may even wear away the wires in certain deserts; window glass, automobile windshields or the finish on an automobile may be seriously sandblasted in a region of sand storms. A sand storm provides one with an experience, which is seldom forgotten. Truly the erosive work of the atmosphere has long been under estimated.

Until the Dust Bowl, or bowls, received their wide attention we were inclined to think of transportation by the atmosphere taking place chiefly in desert regions. However, common dust storms and dust falls on snow in the last two decades have made the public conscious of the ability of the atmosphere as a transporting agent. It has been estimated that the wind in the Mississippi Valley each year transports far more sediment than the river itself carries to the Gulf of Mexico, and the unsupported statement has been made that every square foot of earth surface contains dust derived from every other square foot of the earth. These conjectures may not be rigorously correct but they do point to the fact that the wind is a powerful, ceaseless transporting agent.

Transportation by the atmosphere is further implemented by the fact

Sandstone overlying ancient clays in the Big Badlands.

that material may be injected into it, as when volcanic explosions throw hugh quantities of rock powder into

(To page 23)

A STUDY OF LAKE SUPERIOR AGATE

Interpretation of Structual Forms and Mode of Origin by Superficial Examination

THEODORE C. VANASSE

(Part II)

The onyx varieties of agate are simply those in which layers lie horizontally in planes one upon the other. Sardonyx is red and white or brown and white in alternating layers, but varies considerably from a definite color pattern. Chalcedonyx layers vary from nearly transparent and water-clear to opaque, dense white and blue. Each variety frequently occurs in more than one generation at successively higher levels within the stone. (Fig. 10).

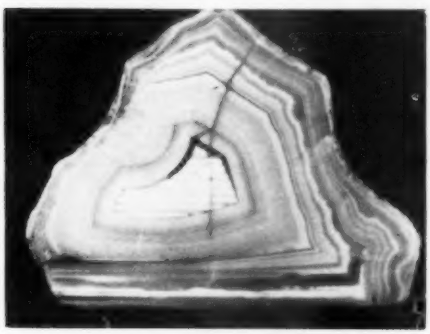


Fig. 10. Fortification-chalcedonyx combination with second generation of chalcedony in center and crowded eye-agate hemispheres in dark band.

Both types, by their very nature, denote either a process of sedimentation or water level deposition. They also offer definite proof of fluctuation in available ground water and hence in available silica and minerals. Individual stones present great variety of complex problems. They demonstrate, for example, that no single mode or theory of formation can fully explain even a single agate. From bottom to top each successive layer and each generation of layers, in combination with associated eyes, quartz crystal bands, normal fortification bands, and central cavity filling, tells the story of changing physical conditions in the earth. The story of drouth, flood, and fire told by the growth rings in an old tree has almost an exact counterpart in the onyx variety of agate. Thus from each individual stone a long chapter of the earth's subterranean history might be written.

Very rarely a stone is found consisting entirely of sardonyx or chalcedonyx. Its exterior conforms to all convolutions of the cavity within which it grew, but there is little if any trace of an outer enclosing layer of carnelian. Such stones are often dense and but slightly colored. The story they have to tell is usually one of extreme subterranean drouth in which the jel rose slowly and intermittently. There were no periods of rise and fall of the water level alternately to fill and empty the cavity. The first and only complete filling occurred when the top layer was deposited against the roof.

A second type grew in the presence of slightly increased quantities of water. As shown by Fig. 10, this type is predominately of the onyx variety with the addition, however, of a distinct but thin outer area of fortification bands. At various depths within this outer area large or small eye-agates were formed by "sweating in" of the silica solution during periods when the cavity was empty. This type indicates fluctuation of available water, followed by a more stable condition of near drouth. (Drouth, as meant here, may have been a strictly local condition, restricted, it may be, to the single cavity itself.)

The agate illustrated in Fig. 10 has another and more complex story to tell. It began with a period of sweating during which small and indistinct though numerous eyes were formed on the walls of the cavity. Then followed an interval of rapid filling and emptying during which the chalcedonyx layers were built up as far as the base of the lower white layers and the fortification bands in as far as the heavy, dark band.

The white layers and the dark band represent another empty cavity period of sweating. The white layers formed first as a flocculent, almost extreme drouth deposit. The fractional, short, angled, white band at the right contains minute eye-agate droplets that may have fallen from the near-dry ceiling. The dark band is formed entirely from distinct and also from completely-merged, nearly-colorless eyes. This dark layer is heaviest in the right lower corner and extends half way across the bottom. It terminates in a distinct eyelet.

A possible explanation of the crowding of the dark layer into the right corner, and also of the apparent disturbance of the white layer to the left of the lower center, may be found in the structure of the upper left part of the stone. All bands on the outer and major portion of the stone thin out and terminate at a spot that was obviously an entrance canal to the cavity. The suspended position of this entrance, together with the disturbed conditions on the bottom, allow a possibility, at least slightly better than mere conjecture, that before the sweated layers had become firm in the cavity a sudden renewal of the water supply could have fallen with force enough to cause the visible alteration. This explanation is offered after a study of many similar stones in which layers are disturbed by the dropping of moisture and even of solid particles from the ceiling above.

This period of sweating and sudden disturbance was followed again by alternate filling and emptying until a time was reached when the cavity stayed full and the fortification bands were formed by the normal process of crystallization out of a supersaturated solution. This process was interrupted once at the narrow dark band which consists of yellowish crystalline quartz. Eventually, toward the center, deposition ceased with the formation of a last incomplete layer of quartz crystals, and the remaining cavity became empty and static. Then later again began the slow process of layer-by-layer deposition of chalcedonyx under near drouth conditions that this time may have been caused partly by the relative imperviousness of the now nearly sealed outer bands.

But even this is not the end of the story told by this single stone. The complex problem of flow-structure must be considered to explain the thickening of bands on the right and of erosion of bands on the left adjacent to the entrance canal. Also the possible and probable presence of unexposed entrance tubes that supplied the central cavity could be investigated by sectioning the stone. Lastly, and more difficult, is an explanation for the disturbed, almost dissepimental character of the white layers of second generation chalcedonyx.

As in this stone, any individual complete agate of the onyx variety presents an entirely unique and complex story that at times is merely conjectural. Theories both old and new apparently fail as strange structural details appear. Yet this apparent failure to explain minor though none-the-less important structural variations should not affect our ultimate understanding of the major, normal agate structures any more than minor deviations from the standard form affect our understanding of other natural phenomena. Quartz crystals, for example, are almost never found as mathematically precise hexagonal prisms. Yet, however distorted by unexplainable factors, the hexagonal symmetry is there.

Eye-Agate

The eye-agate is a small hemispherical body found at or just beneath the surface of the agate proper. Its circular bands resemble strikingly the iris and pupil of the human eye. (Fig. 12). Thus its shape does not refer to nor resemble the lenticular shape of the open lids of the human eye.

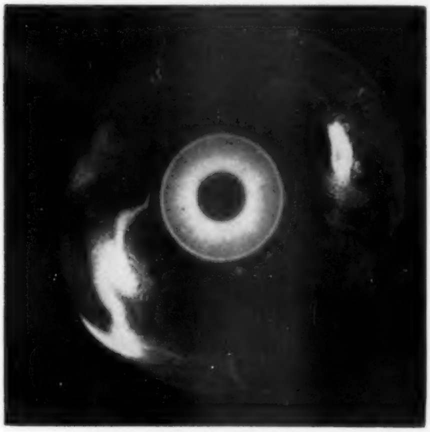


Fig. 12. **Eye-agate strikingly resembling the iris and pupil of the human eye.**

Eye-agates are most frequently found associated with the onyx variety of agate. Usually they occur singly or even in great numbers upon the upper part of the stone. Occasionally, however, they gather less distinctly on the bottom and in the lower corners beneath the onyx layers.

The eyes on the walls and ceiling of such agates were formed in the empty cavity from drops of silica jel adhering to the sweating rock. Those below the onyx layers were formed from a small accumulation of silica sweat on the bottom.

Later filling of the cavity with the silica solution, followed by rapid retreat of the water level, deposited the

Fig. 13. **Often on the upper continuation of onyx layers there were formed new and deeper eyes.**

first layer of onyx on the bottom and formed the first band of silica over the suspended eyes. Repeated alternation of empty-cavity sweating and filled-cavity deposition gradually built up the bottom layers of onyx and the upper agate bands. On the upper continuation of many onyx layers there were thus formed new and deeper eyes. (Figs. 10, 13). Each eye, of course, has its flat side attached to the ceiling, and it is the exposure from the outside of this flat side of the drop that reveals the circular bands of the eye-agate.

This method of formation and this association with onyx indicate that the movement of silica-bearing ground water through the lava flows was slow and intermittent at first. Later the movement increased as ducts and channels became flushed clean. This is further indicated by the fact that eye-agates, and occasionally onyx, were formed only when the cavity was young and empty. Also a hesitant beginning is indicated by the indistinct, refuse-littered appearance of some bottom sardonyx layers. Advanced stages of deposition show increased rapidity and a change to the normal type of agate

formation, followed ultimately in most individual stones by quartz crystal filling in the center.

When a normal, unbroken agate has eyes very near its surface they may often be detected by wetting and viewing toward a strong light. Using this method they appear as dark, round, bean-size shadows beneath the jasperized surface. If the surface is not jasperized, but translucent when wet, the circular bands themselves may sometimes be seen in a strong light. Deeper eyes are often

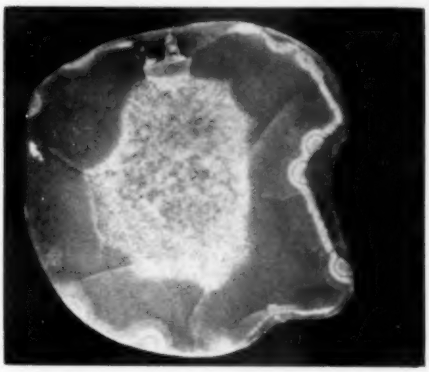


Fig. 14. **Eye-agate hemispheres hidden beneath a thick layer of sard, as exposed by sawing and polishing.**

revealed only by sawing, when they appear around the edges of the cut surface as cross-sections of the hemispheres. (Fig. 14). In all cases, when eyes are detected or suspected, they may be exposed by carefully grinding away the outer layers. (Fig. 15).

The eye-agate, therefore, is a separate entity. It bears no relation to the agate proper in which it is found other than that of support or matrix. Thus the manner of cutting can have no effect upon its appearance or structure, for it is there simply to be revealed, not deftly manufactured by a trick of the lapidary art.

Orientation

As originally conceived, this study of Lake Superior agate was to have had the problem of orientation as its central theme. It was thought that if it were possible always to orient agates along vertical and horizontal axes, the introduction of gravity as an additional function of their formation would by so much facilitate their interpretation. Further, if certain types of agates, or if even a few agates of one type, could be oriented with certainty, then the key to the orientation of all agates might be found in the difference in structure of bands at the top and bands at the bottom, and perhaps also in the differences in external appearance.

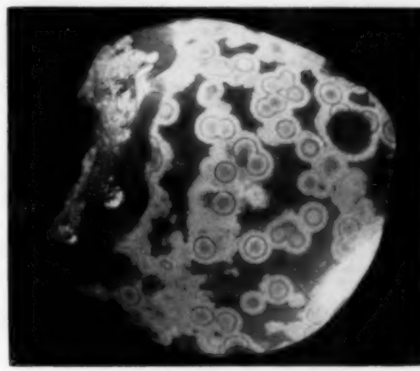


Fig. 15. **Eye-agates exposed by grinding reverse of agate shown in Fig. 14.**

However the present theme has become more general. It has been found possible to orient only two types of agate, one accurately, the other only approximately. And, finally, no invariant differences have at present been established for distinguishing upper and lower bands in all agates.

As discussed in the section on the onyx variety of agate, it is quite obvious that the horizontal planes of banding denote a process that at least resembles sedimentation or water level deposition. Such planes deposited successively from the bottom upward afford an infallible basis for the orientation of the onyx-fortification combination. As seen in all examples of this type, the sardonyx or chalcedonyx lies in horizontal layers, occasionally in several generation alternating with areas of normal fortification or quartz crystal structures. Eye-agates of definite, well-colored form often occur above and indefinite, poorly-colored eye-agates below. Quartz crystal filling, whatever its area, always occurs above.

Within the onyx layers, faulted, eroded, and poorly-laid bands usually occur below the sharply-defined, well-colored bands. This fact affords a means for orienting those occasional stones formed entirely of the onyx variety. Also by such signs we determine the top and the bottom of fragments of sardonyx detached from originally complete agates.

It is often possible to orient such "water level" agates before cutting. Broken and exposed straight bands afford a simple and evident key. In other forms weakness between horizontal bands, which were largely unprotected by enclosing fortification bands, causes the lower layers to break off, leaving one side flat. The flat side is naturally the horizontal side. Such a fracture was the sole means of orienting the stone shown in Fig. 10, which was otherwise unbroken. An occasional dumb-bell shaped nodule reveals onyx bands if sawed perpendicular to the plane of the neck band. This orientation fails, however, if entrance canals lead into both ends or chambers of the double structure.

In agates exhibiting flow or erosion structures the influence of gravity may occasionally provide the key for orientation. This is especially true of agates formed in partially-filled cavities where conditions were not static. (Fig. 6, Part I). Also certain stalactitic growths may be considered as vertically suspended structures. In these structures, however, much more research is necessary before accurate orientation becomes possible.

The problem of orientation is important in the investigation of agate structures, and should prove fruitful if carried on by all who have large collections available. Many Lake Superior agates of the moss and tubular types are as yet unexplained. Also a method is needed by which to distinguish the thinning of bands around entrance ducts from simple erosion or sloughing in flow channels. For example, much more could be explained in such agates as those shown in Figs. 1, 4 (Part I) if one could decide whether the sections were horizontal or vertical. If gravity affects the form of the onyx-fortification type so noticeably, we can be sure that all agates were affected in ways as yet unrevealed.

The Lapidary's Problem

Lake Superior agates confront the lapidary with problems not encountered in agates from other areas. The problems arise from the agate's erratic history. Formed in relatively hard basalt and porphyry, they first

(To Page 25)

FAMOUS LOST MINES

(Sixth of a Series)

VICTOR SHAW

THE LOST BREYFOGLE

The story of the Breyfogle, we think, is no doubt factual so far as its chief features are concerned; but, as is the case with most of the others, many of its detailed events are in question. This is particularly true with respect to the history of the Lost Breyfogle, a prospect said to have been an unusually rich deposit of gold ore in quartz. However, there have been so many accounts of it that do not coincide, some even being contradictory, that the task of co-ordinating them all is very difficult, if not impossible.

One such handed down to us may serve as an example.

According to this story, Breyfogle and several companions were travelling east through southern Inyo County, California in 1863, presumably on a prospecting venture and working gradually toward Nevada. Maybe they were following the old Wingate Trail, for one evening they made camp at the southern end of the Panamint Range, possibly near Ballerat, where there is a known spring, or desert well.

Early next morning they were attacked by Indians. The prospectors all were killed but Breyfogle, who managed to escape and by using skill in hiding and covering his trail through the desert hills managed to reach the Armargosa Desert area, in southwestern Nye County, Nevada. When rescued there, he was barefooted, ragged, and in a state of collapse; but he still was hanging on to samples of very rich gold ore, which he claimed to have gathered from a wide quartz vein full of the same rich gold.

The holes in this tale are obvious, regarding its lack of detail, especially with respect to the matter of where he found that ore. Naturally, he would hardly have told his rescuers, but no doubt he would later have told his friends; and something of its position be known, when he tried to find the vein again and failed.

At any rate, after sifting all accounts, we consider the following account the most logical and authentic. As to that, readers of Earth Science Digest must judge for themselves.

In this respect, the story herewith gives a very good reason why Breyfogle was never afterward able to relocate the outcrop of the vein where he obtained the rich ore samples he brought in. And that ore certainly was something to dream about. They were from 30 to 50 per cent pure gold, the kind that miners commonly call "jewelry rock". It assayed some $100,000 a ton, as is often true in the case of surface gold in rich veins, due to what is termed secondary enrichment.

And this fact has often misled miners of some experience, but who have failed to notice that such ore is confined to the surface, or within a few feet of the surface, dependent upon the relative solidity and lack of fracturing of the vein apex. An old miner's saying is "if I kin jest git depth on 'er, she'll be rich as all gitout!" But, they haven't learned that, while it is true with soluble ores like copper, it is not the case with a majority of quartz gold ores, which are usually t o o solid, unless fractured and/or free from the walls, to allow re-enrichment downward due to oxidization of surface exposures. Primary ore at depth is the index of values for this type of ore.

However, Breyfogle obviously discovered a very valuable deposit, and the chief reason that he subsequently failed to relocate it was due to a severe head injury, inflicted with an ax by a renegade Piute Indian known later as "Ash Meadow Charlie", after the discovery was made and when Breyfogle was trying to get out of the desert. The injury left him mentally deranged, for apparently it never was examined and cared for by a physician, or surgeon. So, it is not so strange that he never was able to find his rich vein again.

As this story goes, Breyfogle's journey was not only taken alone, but it started and ended inside the State of Nevada and for the most part it all occurred inside Nye County. Jim Breyfogle was a prospector and miner, so far as is known, and his home and family in 1863 when these events happened, were in Austin, in southern Lander County, from which he began this prospecting venture.

No doubt he had prospected out from Austin in other directions, but on this trip he started southward into Nye County. Perhaps he had already found that Nevada is a highly mineralized region, beside b e i n g the most arid of any State in the Union. In any case, he is known to have taken his time and prospected carefully, as he treked down through the ranges w h i c h in Nye County all trend roughly north and south with open desert valleys between.

Thus he worked his way slowly southward riding a horse. A few accounts say he had a pack burro and walked, but a majority agree that he had a horse and may have had the customary pack burro, too. He must have been on the west side of Nye County, for this tale says he went through the Halston Desert and along the eastern flanks of the Funeral Range, where it juts out a little into Nevada. From there he kept on into the Armargosa Desert, or possibly its northern border.

For it was in this vicinity that he made his rich discovery.

One evening, when about to make camp, he was caught by one of the sudden sand storms so prevalent in these deserts; and the furious sand-laden winds drove him to seek shelter among the cliffs at the base of a near-by mountain. He found a cave under an over-hanging cliff, hobbled his horse and turned him loose, got his supper and rolled into his blankets to sleep soundly ignoring the familiar wind storm.

But next morning, while getting breakfast, he noticed that his horse was nowhere in sight and left at once to search for it. He had no trouble picking up the animal's tracks and for some time trailed them up and down and around, even finding the hobbles with the strap broken, but search as would he could not locate his valuable mount. It placed him in a serious position of course, so back at the cave he got something to eat, then started up the mountain to see what its other side might show up, for the horse tracks had trended generally uphill.

Upon the summit, which commanded all of both sides of that mountain as well as the surrounding country, he used his field glass to examine every ridge slope, canyon, and upland basin for a sign of the strayed animal. On his right, he afterward said, stood a heavily timbered mountain and on the left stretched a broad valley well mantled with a profusion of vegetation, both of these being decidedly unusual in the midst of that very arid desert region.

While thus engaged, being weary from his long climb, he leaned against a rocky ledge that jutted waist-high from the ground, but gave it no more than a passing glance at the time. Failing then to locate his horse, he decided to move to a high point beyond for a wider view. One hand had been rested on the ledge, and as he started away it chanced to dislodge and turn over a fragment of loose rock and a gleam from it in the sunlight caught his eye. Of course he picked it up, and a closer examination revealed so much gold that he had to test it with his knife point to make sure it wasn't pyrites. But it was gold all right, and the fragment seemed more than half pure metal.

More than that, the jutting ledge was all composed of rotten quartz like the chunk in his hand, and he could see the yellow glint of gold all through it plainly shining in both directions. Very excited, he examined the ledge both ways along its course finding not a break in its content of glittering yellow metal. At last he had found what he had always been looking for.

How long he spent tracing the wide heavy vein, forgetting his strayed horse and everything else, he never knew; for the unusual amount of gold and the size of the outcrop indicated a large and very rich mine. He had found a real fortune, enough to keep himself and his family and his grandchildren in luxury for all their lives. So in planning how best to de-

velope his find, time passed unheeded.

But he was aroused at last by a pressing thirst and followed on along the outcrop in search of a possible spring, or natural tank. Also, he kept a keen eye out for his horse, his sole means of travel back to his family with his wonderful news. He had taken all the gold samples he could carry, but its weight was ignored as he hastened along the outcrop, which seemed to form the core of the mountain range. At long last, he finally caught sight of the fresh green of willow, brush, and weeds, in a ravine that formed a saddle between peaks, where cool water seeped from a fault seam in the mountain.

After drinking all he could hold, he was aware of a ravenous hunger; also being much worried about his horse, he started back toward the cave where he left his outfit — or so thought. He must have been badly confused, for he never found the cave and its food and the horse stayed lost, not only when night closed in but next day and afterward.

Followed then his frantic attempt to get out of the desert, which swiftly developed into a nightmare of torture: of searing heat, a gnawing hunger, griping thirst for water to moisten his parched and swollen tongue, and a devastating weakness caused by dehydration that soon kept him stumbling to a fall after fall, regardless of stones, or brush, and devilish cholla cactus that seemed always in his path.

In a frenzy of delirium it is certain that he didn't know in what direction he was going, and that only his will to survive kept him ever rising to plow ahead through the soft clogging sand, only to stumble and fall again . . . until finally, when practically out on his swollen blistered feet he staggered into a place that is known as "Stump Springs". It was merely a desert watering place, some 9 miles from Manse Ranch and 20 or so miles airline southeast of the settlement of Death Valley Junction.

But unluckily there chanced to be a party of wandering Piute Indians camped at Stump Springs, who didn't care much for any pale faced humans; beside which, one of them happened to be a well known "bad Indian", afterward dubbed "Ash Meadow Charlie" because he lived for a while at Ash Meadow, from which he carried on his raids. The Indians handled the stricken Breyfogle very roughly, and when he could not get up, Ash Meadow Charlie hit him on the head with an ax and would doubtless killed him had not another Indian intervened. As it turned out, they loaded him upon a horse when they moved camp, but dropped him a short distance from Las Vegas; to which he managed to drag himself after they moved on, and where he was taken in and given adequate care.

All this time he had clung to his ore samples, oddly enough, and he still had them when weeks afterward he recovered sufficiently to be sent home to his family in Austin. There, during the next several months of forced rest, there were intervals when his disordered mind cleared enough to function normally. It was then that he told of his marvelous discovery and what he could recall of the hardships endured while wandering through the desert. His whole story seemed incredible, yet that he had found a rich ore vein was proved by the samples he brought back and this had to be accepted. When he had the samples assayed, they were found to run well over $100,000 a ton. By itself, this means little. Many operating gold mines have pockets of ore affording picked specimens that run as much, or even more, but trouble is you seldom are able to get a ton of it.

Anyway, from all accounts there seems to be no question that Jim Breyfogle found an apex of a very rich ore vein, and from his description of its width and length it is possible that it could be developed into a very valuable mining property. The catch then was that afterward he never was able to find that mountain, with the cave containing his outfit under the cliffs at its base.

Yet, when able to travel again, he certainly tried his best to relocate it, and kept persistently at it until his death. He argued his friends into going with him, and is said to even have hunted up Ash Meadow Charlie and tried to persuade him to help. Also it is reported that there is a place, still to be recognized, where a number of his trails meet. It is said to be on the eastern side of the Funeral Range where it approaches Death Valley; a centrally located point, from which he used to set out in all directions in order to cover each portion of the desert region he thought he might have been in. It is locally called "Breyfogle's Dispair", for he died defeated.

Through the years since then many have hunted in vain for it. And this, as in other similar cases, led to the discovery of a mine called the "Johnny Mine"; a quartz gold property with highgrade ore, which owing to its similar position some think may be the long lost Breyfogle. On some maps we have on file, this Johnny Mine is marked in position at the southern end of the Belted Range, which lies near the Clark County boundary in southeastern Nye County. As to whether this is true, or not, readers can use their judgment. We have come to no decision either way.

Whatever the truth may be, the fact remains that practically all these desert hills lie within a well mineralized belt, where rock formations definitely are favorable for gold deposits. Most of them are intrusive eruptives lying within areas of surrounding metamorphic sedimentary rocks, similar to many in southeastern California. And this belt in southern Nye County, Nevada, extends in a general southeasterly direction across the Colorado River to appear in the noted Oatman mining district in Arizona.

For this reason, even if the Lost Breyfogle is not the objective, prospecting southern Nye County still is well justified.

A STORY IN STONE

An Unusual Occurrence of Lepidodendron

By Harrell L. Strimple

One of the most common objections to geological studies, given by the uninitiated, is the lack of "life" involved — just cold stone. In truth there is a much greater story of living in a single rock than in an entire "popular" library. An excellent example of such a story was afforded on a recent field trip when a fairly large piece of *Lepidodendron* was found on an outcrop of the Fayettville formation in Northeastern Oklahoma. It does not sound very promising I am certain, but is in reality a most complex problem.

The Fayettville formation is a marine shale deposit, with some thin lenses of impure limestone, capped by a hard marine formation known as the Pitkin Limestone. Both are members of the Chester Series (late Mississippian). *Lepidodendron* is a non-marine plant and this particular specimen is a fine-grained, reddish sandstone casting, entirely foreign to the immediate area. From this point on the story could be quite lengthy and complicated but an effort is made to have it as brief as possible.

Deposition of the shale and limestone took place during a major sea invasion of the North American continent during a period of time known as the Mississippian Period. It is known that Scale-trees appeared late in the preceding Devonian Period, and that they existed during the Mississippian, but for some reason are not known from the later period except in exceptionally poor preservation. There are several places low on the outcrops where pebbles and similar foreign debris are to be found, which were obviously deposited subsequent to the shales, and apparently under non-marine circumstances. In fact two crinoid specimens that most certainly were eroded out of the original shale and redeposited in the "pebbly" zone have been found.

Design in nature. The leaf scars of *Lepidodendron* on a section of the trunk.

The next major submergence affecting northeastern Oklahoma took place in the following Pennsylvanian Period when great swamps and much vegetation existed. According to the paleogeographic maps all of this area was covered by oceans or shallow seas, but I have personally hiked over numerous miles of these low hills in the portion of Craig County under question, without finding a single vestige of Pennsylvanian deposition, however, Pennsylvanian sandstones do exist a few miles to the west and *Lepidodendron* is known to occur there.

One is therefore forced to the conclusion that subsequent to the depositions of Mississippian and some portion, if not all, of Pennsylvanian time, some large body of water was present in the area, probably a great river, and under stress of storms this rather heavy specimen was swept along from its original resting place and redeposited in the locale where found.

For the benefit of those not familiar with paleobotany, tree life in Pennsylvanian time consisted of forms existing today only as rudimentary decendents. There were numerous scouring-rushes, the largest being *Calamites*. The stem was regularily joined with each joint bearing a whorl of simple leaves, known as *Annularia*, and the stem was vertically ribbed. Scale-trees were mostly represented by *Lepidodendron* or *Sigillaria*. The former branched repeatedly near the top and had slender strap like leaves which left diamond shaped scars. The later rarely branched and had a much larger trunk. Trunks with a diameter of 6 to 10 feet and a length of 100 feet have been observed. Present day conifers were represented by the group *Cordaites*. There were also numerous ferns, many of which attained tree like proportions.

If one possesses the imagination to visualize those tremendous, teaming swamps of the Pennsylvanian, the most weird landscape ever to be known on the face of this earth must result. It was under such circumstances that animals emerged from the sea as amphibia and became permanently established on land as the reptiles. Henceforth land animals invaded all life realms and dominated the entire earth, some even returning to the sea as, for example, the marine reptiles and the whales. But that is another story, a great story of life preserved in stone.

The specimen discussed herein has been deposited in the collections of the Paleontological Research Institution, Ithaca, N. Y.

(From page 8)

the air. The explosions of Katmai in Alaska, and Krakatoa in Indonesia, are classic examples within historic time when as much as several cubic miles of rock dust were violently and suddenly dispersed in the atmosphere, and remained in suspension long enough for it to travel several times around the earth. Widespread volcanic ash or dust deposits which constitute part of geologically old sedimentary rocks attest to volcanic action and transportation by the atmosphere many times in the geological past. The microscopically fine, angular, sharp, uniform-size, glassy rock fragments or *shards* which settled through the atmosphere millions of years ago are quarried and processed today to become the base for household scouring and cleansing powders. Hence, deposits of the atmosphere are economically valuable to offset the destructive action of wind abrasion and removal.

Perhaps the best known wind deposits are the sand dunes which are abundantly developed in deserts, on ocean and lake beaches, and along stream valleys which flow through semi-arid to arid continental interiors. In our United States we find sand dunes abundantly developed west of Yuma, in Death Valley, along the Columbia River, down the Pacific coast, along the Gulf and Atlantic coasts, on the shores of Lake Michigan, and along parts of the Arkansas River in Kansas. This list does not begin to exhaust all of the sand dune localities but it illustrates a few of the type localities where sand dunes are easily accessible to the tourists. The sand in the dunes just mentioned is composed primarily of quartz but other accessory rock minerals are also associated. Quartz is so common a constituent of sand that we hardly think of any other mineral being present.

The great White Sands National Monument which is located near Alamogordo, New Mexico, (see photo Page ?) is a sand dune area in which the sand is composed of the mineral gypsum. It is an interesting experience to visit these dunes which glisten like snow drifts in the brilliant sun light, and to find that the particles making them up are not as hard or abrasive as one's thumb nail. Whereas quartz sand is exceedingly gritty between one's teeth this gypsum sand may be chewed without harm to the teeth (or to any substance having a hardness greater than two).

Geologically ancient dune areas have been consolidated, or have been reworked by advancing seas and buried to give rise to thick, relatively pure sandstone formations.

Although sand dunes usually do not support lush vegetation, some deposits of the atmosphere are notable for their high agricultural productivity. The Palouse soil of the northwestern United States is rich in mineral plant nutrients and is responsible for much of the excellent farm land of that area. Throughout the Missouri, Mississippi, and Ohio vallies the loess, a wind blown deposit, gives rise to much of the productive soil in the central United States. The loess is thickest and most characteristically developed along the north and eastern banks of the large rivers mentioned above, and may be recognized by its fine grain, its buff color, and its ability to stand in vertical walls (probably due to calcium carbonate cement). The loess commonly overlies glacial drift and is thought to have been deposited in great abundance following the melting of the Pleistocene ice sheet, but deposition is probably continuing through the present time. While the glacial ice was melting, large quantities of quartz-rich rock fragments of about silt-size were carried by melt water into swollen streams which overflowed their floodplains, and were left as silt-sized fragments of rocks.

During windy, cooler, and drier seasons the prevailing southwesterly winds swept across the floodplains and picked up much of the silt and dropped it on near-by high bluffs and the hinterland back of the rivers to form the loess deposits and soils which are rich in wind-carried material. Even today strong, hot dry winds pick up dust on the sand bars and flood deposits of the large rivers of our central states and continue to add to the wind deposits which probably accumulated much faster in earlier times. The buff to yellow loess is classic in its development along the Yellow River in China, and along the Rhine River in Germany.

With the realization that the atmosphere conditions our climate, furnishes oxygen for us to breathe, sandblasts and carves solid rocks, and then furnishes us industrial products and rich agricultural soils we must recognize that the atmosphere is one of the most important of the geological physical agents.

The weight of the air in a room 12 by 16 feet, and 10 feet high is approximately 150 pounds.

(From Page 14)
endured what may often have been a violent release. Many of them may have been pounded and rolled on the beaches of our ancient inland seas. Later they were picked up by advancing glacial ice and further ground and rolled under its tremendous weight as they were carried often hundreds of miles. Post-glacial and recent erosion released them once more from the gravel or boulder deposits and subjected them to repeated grinding action of shifting creek bottoms. And continuously they were exposed to all vicissitudes of weather—the strain of frost and the cutting edge of wind-blown sand.

As a result most Lake Superior agates are found as fragments, or, if whole, are seriously checked. Perhaps as few as 2 per cent of all banded agates are completely free from cracks. Mossy varieties, lacking the inherent weakness of the banded structure, are less subject to fracture and are found in larger sizes. Fragments and checked specimens have less value as collection or cabinet specimens, unless they exhibit rare color or structural patterns. They provide cabochon material for the lapidary, who may saw larger fragments into gem slabs after a careful consideration of checks and cracks. Widely spaced checks are of little consequence in cabochon work, and indeed are often beneficial in that such slabs may be simply snapped with the fingers to obtain excellent material for grinding.

The lapidary must decide first of all for each stone the direction of sawing or manner of grinding. His decision involves two influencing and mutual factors. First a preliminary superficial examination should be made to determine the variety and the structures present. Second, on the basis of this examination he should decide the purpose for which the stone may be cut and the ultimate use of the parts.

The preliminary examination, as we have attempted to show, should reveal most of the more important and beautiful agate structures. The lapidary may discover that it is possible to orient a stone. If so, sardonyx or chalcedonyx may be present in combination with other agate structures. Eye agates may be detected and afford a further hint toward orientation. Unusual contrasting spots and rings may reveal duct entrances and thus tell something of interior banding patterns. Location and number of quartz areas indicate simplicity or complexity of banding structure and total quantity of quartz present. Dark, porous areas may indicate sagenite, striations or circled areas enclosed crystals or tubular agate. And so on and on until the lapidary has deduced as many as possible of the agate's internal secrets.

Now and only now is the lapidary ready to cut his stone. But why?

A practice among many who saw Lake Superior agates has been to saw for the largest surface. This practice originated and has persisted for two reasons. The first is monetary—so much per square inch both in sales and in custom sawing. The second rests in an unvoiced rivalry based on the fact that Lake Superior agates "run small" and each collector takes pride in his largest agate. If size, then, is the purpose, no problem not mechanical is involved.

A second and more satisfactory method is to saw for the most complete banding pattern. Checked and broken stones often retain enough exterior layers to enable a careful lapidary to avoid the less attractive fractional and U-shaped banding on his cut surfaces.

Variation in structural detail demands an equal variation in cutting technique. Whereas a surface known to contain numerous eye-agates indicates only grinding and polishing, pipe agates may be sawed either parallel or in cross-section according to individual preference. Cross-section cuts in pipe or tubular agate yield a surface covered with circular banding resembling eye-agate. Parallel or diagonal cutting yields other pleasing patterns of obvious design. Sagenitic agates are usually cut in the plane of the needles as nearly as possible to obtain the radiating fibrous effect. Cut across they show simply a speckled surface that is often difficult to polish since the needles are often hollow. Entrance canals sawed longitudinally yield swirls of banding and greatest variation in band thickness. In addition such cuts afford greater facility in interpretation. Vein agate may be cut lengthwise at varying depths for a pleasing effect of spots and circles, or cut across the vein to show stalactitic growths and crystal filling.

The onyx-fortification combination produces the greatest beauty and variety of agate structure when properly cut. Since they are "complete" agates when cut vertically, they amply repay the lapidary for his thorough preliminary examination. If, in addition to sawing vertically, the cut can be made through an entrance canal, additional beauties of banding are revealed. Such stones make the finest of cabinet specimens, and should never be sacrificed for cabochon material in view of the abundant fractured specimens.

Summary

To summarize, this study has attempted to show:

1. That current agate theory must be revised to include a possible explanation for intricately varying structural detail.

2. That the characteristics of the varying structural forms are most important among the criteria by which a correct and unified theory of agate formation may eventually be determined.

3. That color in Lake Superior agates was not rhythmically deposited during the time of formation, but is the result of weathering in contact with iron minerals.

4. That by a systematic superficial examination it is possible to discover most of the hidden structural details before cutting, thereby insuring exposure of structures of scientific interest and value that are otherwise missed or destroyed by hasty improper cutting.

5. That the problem of orientation has an intimate bearing upon structural interpretation, and is therefore a problem for which a complete solution should be sought by all who have agate collections.

(Editor's Note: A number of copies of the August issue are still available to those readers interested in the intriguing problem of the formation of agates who do not have Part I of the article by Mr. Vanasse.)

The November issue of the Earth Science Digest will contain another fascinating account of a famous lost mine by Victor Shaw and other interesting articles including "Zeolites" by Richard M. Pearl.

CLASSIFIED ADVERTISEMENTS

Rate 6c per word. Minimum advertisement $1.50. All ads must be in our office on the tenth of the month preceding date of issue.

BOOK REVIEW

Benjamin Silliman, Pathfinder in American Science

By John F. Fulton and Elizabeth H. Thomson. Henry Schuman, New York. (Illustrated) $4.00.

Here is a new book which fills a niche in the library of every student of the history of the earth sciences. Through his efforts in teaching the sciences at Yale, Benjamin Silliman laid the foundations of science education in the United States. As a geologist and chemist of the first rank, and at a critical period in our history, he fostered the sciences more effectively than any other figure in the first half of the nineteenth century.

Silliman in 1818 launched the *American Journal of Science*, known as *Silliman's Journal*, which still flourishes. He established the great natural history museum, the Peabody. He played a leading role in the establishment in 1847 of Yale's scientific school, later called the Sheffield Scientific School, which marked the beginning of professional scientific education in the United States.

It is a far cry from Silliman's laboratory, placed underground by a cautious architect who wanted to protect the college from extinction by exploding chemicals, to the modern scientific laboratories which produced the atomic bomb, but the story, told by John F. Fulton and Elizabeth H. Thomson, is full of interest and meaning for the thoughtful reader who recognizes the necessity of an awareness of America's scientific history as an increasingly important aspect of its general history

Dr. Fulton is Sterling professor of physiology and chairman of the advisory board of the historical library of the Yale University School of Medicine, where the co-author is research assistant. The book is recommended by the Book-of-the-Month Club and is offered by the Book Shelf of *The Earth Science Digest.*

GEMS FROM GEOLOGY

The Author of "The Origin of Species" Discovers Petrified Trees.

(Seldom does the student of the earth sciences have time to search through the older writings for the significant chapters which cleared the way for progress in geology. Yet the works of those men who opened new vistas in the science merit occasional revival. The Digest will present from time to time this feature, Gems from Geology. Charles Darwin performed notable service through his geologic observations during his cruise around the world on H.M.S. Beagle (1832-36). Here is his account of a journey into the Andes.)

The solitary hovel which bears the imposing name of Villa Vicencio has been mentioned by every traveller who has crossed the Andes. I stayed here and at some neighboring mines during the two succeeding days.

The geology of the surrounding country is very curious. The Uspallata range is separated from the main Cordillera by a long narrow plain or basin, like those so often mentioned in Chile, but higher, being six thousand feet above the sea. This range has nearly the same geographical position with respect to the Cordillera, which the gigantic Portillo line has, but it is of a totally different origin: it consists of various kinds of submarine lava, alternating with volcanic sandstones and other remarkable sedimentary deposits; the whole having a very close resemblance to some of the Tertiary beds on the shores on the Pacific.

From this resemblance I expected to find silicified wood, which is greatly characteristic of those formations. I was gratified in a very extraordinary manner. In the central part of the range, at an elevation of about seven thousand feet, I observed on a bare slope some snow-white projecting columns. These were petrified trees, eleven being silicified and from thirty to forty converted into coursely-crystallized white calcareous spar. They were abruptly broken off, the upright stumps projecting a few feet above the ground. The trunks measured from three to five feet each in circumference.

Mr. Robert Brown has been kind enough to examine the wood: he says it belongs to the fir tribe, partaking of the character of the Araucarian family, but with some curious points of affinity with the yew. The volcanic sandstone in which the trees were embedded, and from the lower part of which they must have sprung, has accumulated in thin layers around their trunks; and the stone yet retained the impression of the bark.

It required little geological practice to interpret the marvelous story which this scene at once unfolded; though I confess I was at first so much astonished, that I could scarcely believe the plainest evidence. I saw the spot where a cluster of fine trees once waved their branches on the shores of the Atlantic, when that ocean (now driven back 700 miles), came to the foot of the Andes. I saw that they had sprung from a volcanic soil which had been raised above the level of the sea, and that subsequently this dry land, with its upright trees, had been let down into the depths of the ocean.

In these depths, the formerly dry land was covered by sedimentary beds, and these again by enormous streams of submarine lava — one such mass attaining the thickness of a thousand feet; and these deluges of molten stone and aqueous deposits five times alternately had been spread out.

The ocean which received such masses must have been profoundly deep; but again the subterranean forces exerted themselves, and I now beheld the bed of that ocean, forming a chain of mountains more than seven thousand feet in height. Nor had those antagonistic forces been dormant, which are always at work wearing down the surface of the land; the great piles of strata had been intersected by many wide valleys, and the trees, now changed into silex, were exposed projecting from the volcanic soil, now changed into rock, whence formerly, in a green and budding state, they had raised their lofty heads. Now, all is utterly irreclaimable and desert; even the lichen cannot adhere to the stony casts of former trees.

Vast and scarcely comprehensible as such changes must ever appear, yet they have all occurred within a period, recent when compared with the history of the Cordillera; and the Cordillera itself is absolutely modern as compared with many of the fossiliferous strata of Europe and America.

LOS ANGELES HOLDS FIRST ANNUAL PICNIC

Approximately 400 rock collectors attended the first annual picnic sponsored by the Los Angeles Lapidary Society at Oak Grove Park, near Pasadena, on Sunday, September 14.

The program included an old-time geode gathering "gab fest," nodule races and rock-necking contest. About 200 prizes, with a total value of more than $1,000 were awarded. Donors were members of the host society, two members of the Old Baldy Mineral Society, the M.D.R. Manufacturing Co., R. & B. Art-Craft Co., Allen Lapidary Equipment Co., Hickerson Supply, J. J. Jewelcraft, Theodore's, Grieger's, Highland Park Lapidary Supply, S-T Gem and Mineral Shop, the Lapidary Journal, Ultra-Violet Products, Charles Jordon, Edward and the Valley Craft Shop.

Sixteen mineral societies were represented. Ten Bennett was picnic chairman.

American Federation

Formation of a coast-to-coast federation of mineralogical and geological societies awaits ratification of the constitution of the American Federation of Mineralogical Societies by the California and Rocky Mountain federations. The Midwest Federation of Geological Societies already has ratified the constitution drawn up last June at Salt Lake City. When ratification by proposed member groups is completed, the national organization will proceed to coordinate the efforts of the unit organizations and promote the growth and expansion of popular interest in the earth sciences.